FOREWORD

This is the 27th annual progress report of the California Department of Water Resources' San Francisco Bay-Delta Evaluation Program, which is carried out by the Delta Modeling Section. This report is submitted annually by the Section to the California State Water Resources Control Board pursuant to its Water Right Decision 1485, Term 9, which is still active pursuant to its Water Right Decision 1641, Term 8.

This report documents progress in the development and enhancement of the Bay-Delta Office's Delta Modeling Section's computer models and reports the latest findings of studies conducted as part of the program. This report also includes contributions related to field work conducted by the Division of Planning and Local Assistance's Central District Special Studies Section that could be used to answer questions similar to those that are often directed to the numerical models also described here. This report was compiled by Michael Mierzwa, with assistance from Jane Schafer-Kramer and Wanda Headrick under the direction of Bob Suits, Senior Engineer, and Tara Smith, program manager for the Bay-Delta Evaluation Program.

Online versions of previous annual progress reports are available at:

http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm

For more information contact:

Tara Smith tara@water.ca.gov (916) 653-9885

-or-

Bob Suits suits@water.ca.gov (916) 653-8637

TABLE OF CONTENTS

	FOREWORD	iii
1	INTRODUCTION	1-1
2	SACRAMENTO DEEP WATER SHIP CHANNEL FLOW	
	MONITORING	2-1
2.1	Introduction	2-1
2.2	Methods	
2.3	Results	
2.4	Conclusions	
2.5	Reference	2-5
3	DEVELOPING A RESIDENCE TIME INDEX TO STUDY	
	CHANGES IN 1990 – 2004 DELTA CIRCULATION PATTERNS	
3.1	Introduction	
3.2	Methodology	
3.3	Model Calibration	
3.4	Calculation of Residence Time Indexes	
3.5	Model Boundary Conditions	
3.6	Results	
3.7	Future Directions	
3.8	References	3-12
4	USING VOLUMETRIC FINGERPRINTING TO STUDY SOURCES	
	OF SALINITY IN THE SOUTH DELTA	
4.1	Introduction	
4.2	Background	4-1
4.3	Comparing Observed EC to Results of Modeled Fingerprinting	
4.4	Modeling Fingerprinting and EC for Modified SWP Pumping	
4.4.1	Validation of DSM2's Simulation of EC in the South Delta	
4.4.2 4.4.3	Delta Conditions with Modified SWP Pumping	
4.4.4	2002 Fingerprints and EC	
4.4.4 4.5	2003 Fingerprints and ECSummary and Conclusions	
4.5 4.6	References	
4.0	References	4-2 1
5	A RELATIONSHIP BETWEEN VERNALIS AND BRANDT	
	BRIDGE ELECTRICAL CONDUCTIVITY	
5.1	Introduction	
5.2	Data Characteristics	
5.3	Statistical Analysis	5-3

6	USING DSM2 TO DEVELOP OPERATION STRATEGIES FOR SOUTH DELTA IMPROVEMENTS PROGRAM'S PROPOSED PERMANENT GATES	6-1
6.1	Introduction	
6.2	Overview of South Delta Channel Problems	
6.3	Development of Plan C Gate Operations	
6.3.1	Plan A Operation	
6.3.2	Plan B Operation	
6.3.3	Plan C Operation	
6.4	Plan C and Modified Plan C Gate Operation Rules	
6.5	Summary and Recommendations	
6.6	Reference	
7	ESTIMATES FOR CONSUMPTIVE WATER DEMANDS IN THE	
	DELTA USING DETAW	7-1
7.1	Introduction	7-1
7.2	Background	7-1
7.3	Description of DETAW	
7.4	DETAW's 168 Subareas	
7.5	Calculating Daily Precipitation by DETAW Subarea	7-7
7.6	Calculating Daily ETo by DETAW Subarea	7-8
7.7	Calculating Daily ETAW	7-9
7.8	Summary	7-9
7.9	References	7-10
8	PRIORITY 3 CLIFTON COURT FOREBAY GATE OPERATIONS	
	FOR EXTENDED PLANNING STUDIES	8-1
8.1	Introduction	8-1
8.2	Background	8-1
8.3	General Methodology	8-3
8.4	Impact of Priority 3 Forebay Intake Gate Operation on DSM2-Generated	
	Water Levels	8-4
8.5	References	8-11
9	DSM2 SIMULATION OF HISTORICAL DELTA CONDITIONS	0.4
	OVER THE 1975 – 1990 PERIOD	
9.1	Introduction	
9.2	Input Data	
9.3	Discussion	
9.3.1	Stage Simulation	
9.3.2	Flow Simulation	
9.3.3	EC Simulation	
9.4	Impacts of DICU Estimates on DSM2-simulated EC	
9.5	Summary and Conclusions	
9.6	Recommendations	
9.7	References	9-12

USING PARTICLE TRACKING TO GENERATE INDEXES OF	
FISH ENTRAINMENT POTENTIAL	10-1
References	10-14
DSM2 Users Group Update	11-1
	USING PARTICLE TRACKING TO GENERATE INDEXES OF FISH ENTRAINMENT POTENTIAL Introduction Background PTM Setup for Historical 2005 Delta Conditions PTM Results for Historical and Modified 2005 Delta Conditions PTM Results for Historical Conditions PTM Results for Modified Conditions (No Temporary Barriers) Period Average PTM Results for Historical Conditions Summary and Conclusions References DSM2 Users Group Update Introduction Group Members Meetings Format Update Items Presentation Topics Website and Bulletin Board Survey Results Future Directions

TABLES

Table 3.1:	Range of monthly-averaged 75% residence time indexes for Freeport and Vernalis injections (in days)	3-8
Table 5.1:	Descriptive statistics of monthly-average EC at Vernalis, Mossdale, and	0
	Brandt Bridge	5-2
Table 5.2:	Required monthly-averaged EC at Vernalis to ensure compliance with	
	the Brandt Bridge EC standards	5-5
Table 6.1:	Operation of Head of Old River Gate (Fish Gate)	6-5
Table 6.2:	Operation of Agricultural Gates	6-5
Table 10.1:	Timing of temporary barrier installation and removal for 2005	11-3

FIGURES

Figure 2.1:	USGS quad map of the Sacramento Deep Water Ship Channel study area	2-1
Figure 2.2:	Sacramento Deep Water Ship Channel Boat Lock from upstream end	
	near Sacramento River	
Figure 2.3:	Water leaking through the closed boat lock	
Figure 2.4:	Calculated flow vs. measured flow just downstream of the locks	
Figure 3.1:	Overview of modeling methodology to calculate residence time indexes	3-2
Figure 3.2:	Example of tracking a single Vernalis particle injection	
Figure 3.3:	Cumulative residence time function for a single date of particle injection	3-5
Figure 3.4:	Creating annual residence time indexes using daily cumulative resident time functions	3-5
Figure 3.5:	Significant Delta boundary flows and exports (1990 – 2004)	
Figure 3.6:	Monthly-averaged 75% residence time indexes for a Freeport injection	
Figure 3.7:	Monthly-averaged 75% residence time indexes for a Vernalis injection	
Figure 3.8:	Examples of potential future applications for residence time indexes	
Figure 4.1:	Locations of south Delta water quality objectives	
Figure 4.1:	Historical EC at locations of south Delta water quality objectives, 2001-	4-1
rigure 4.2.	2003	4-3
Figure 4.3:	Volumetric fingerprint of historical conditions in Clifton Court Forebay	
i iguie 4.5.	(Source: DSM2 simulation of historical conditions)	4-4
Figure 4.4:	Observed EC and DSM2-generated volumetric fingerprint of historical	4-4
Figure 4.4:	conditions at Brandt Bridge	4-5
Figure 4.5:	Observed EC and DSM2-generated volumetric fingerprint of historical	4-5
i igule 4.5.	conditions at Old River near Middle River	4-6
Figure 4.6:	Observed EC and DSM2-generated volumetric fingerprint of historical	4-0
rigure 4.0.	conditions at Old River at Tracy Road	4-7
Figure 4.7:	Observed and DSM2-simulated EC at Brandt Bridge, 1991-2004	
Figure 4.8:	Observed and DSM2-simulated EC at Old River near Middle River,	
riguio iio.		4-10
Figure 4.9:	Observed and DSM2-simulated EC at Old River at Tracy Road, 1991-	
J	2004	4-11
Figure 4.10:	Historical SWP and CVP pumping and San Joaquin River inflow in 2002	4-12
Figure 4.11:	Historical SWP and CVP pumping and San Joaquin River inflow in 2003	
Figure 4.12:	DSM2-modeled EC and volumetric fingerprint at Brandt Bridge for 2002	
1 19010 11121	historical and modified conditions	4-14
Figure 4.13:	DSM2-modeled EC and volumetric fingerprint at Old River near Middle	
ga	River for 2002 historical and modified conditions	4-15
Figure 4.14:	DSM2-modeled EC and volumetric fingerprint at Old River at Tracy Road	+ 10
riguic 4.14.	for 2002 historical and modified conditions	<i>1</i> -16
Figure 4.15:	DSM2-modeled EC and volumetric fingerprint at Brandt Bridge for 2003	4-10
1 igule 4.15.	historical and modified conditions	/ ₋18
Figure 4.16:	DSM2-modeled EC and volumetric fingerprint at Old River near Middle	4-10
rigule 4.10.	River for 2003 historical and modified conditions	1 ₋10
Figure 4.17:	DSM2-modeled EC and volumetric fingerprint at Old River at Tracy Road	4-18
rigule 4.17.	for 2003 historical and modified conditions	4.20
Fig F 4.		4-20
Figure 5.1:	Locations of Vernalis, Mossdale, and Brandt Bridge on the San Joaquin	<i>-</i> 1
Figure 5 Oc	River	5-1
Figure 5.2:	Box plots of monthly-average EC at Vernalis, Mossdale, and Brandt	
Figure 5 Oc	Bridge	5-2
Figure 5.3:	Brandt Bridge vs. Vernalis monthly-averaged EC	5-3
Figure 5.4:	Required Vernalis EC to ensure target Brandt Bridge EC at different	
	confidence levels	5-4

Figure 5.5:	Monthly-averaged EC at Mossdale vs. Vernalis	5-6
Figure 6.1:	South Delta permanent gate operation for low San Joaquin River flows (SJR < 2500 cfs) or Old River at head gate closed	6-6
Figure 6.2:	South Delta permanent gate operation for intermediate San Joaquin	
	River flows (2500 < SJR < 4000 cfs) and head of Old River gate open	6-7
Figure 6.3:	South Delta permanent gate operation for high San Joaquin River flows	
	(4000 < SJR < 8000 cfs) and head of Old River gate open	6-7
Figure 6.4:	South Delta permanent gate operation for very high San Joaquin River flows (SJR > 8000 cfs)	6-8
Figure 6.5:	South Delta permanent gate operation for Modified Plan C (Jun. – Sep.) low San Joaquin River flows (800 < SJR < 2500 cfs) and head of Old	
	River gate closed	
Figure 7.1:	Delta land use in non-critical or non-dry water years	
Figure 7.2:	Delta land use in critical and dry years	
Figure 7.3:	Base map for 142 Delta subareas in DICU	
Figure 7.4:	Digitized map of the 142 Delta subareas in DICU	
Figure 7.5:	DETAW's 168 subareas	7-6
Figure 7.6:	Thiessen polygons delineating the association of subareas with precipitation stations	7-7
Figure 7.7:	Correction factor isolines for the Harvey-Samani and the Pennman-	
	Montieth equations	7-8
Figure 7.8:	Typical daily-varying water balance for a crop	
Figure 8.1:	View of the Forebay gates from across Old River on Coney Island	
3 · · ·	(photograph taken by Mike Burns)	8-2
Figure 8.2:	Aerial view of the Clifton Court Forebay inlet	
Figure 8.3:	Priority 3 Clifton Court Forebay gate operation during spring tide	
Figure 8.4:	Example of Clifton Court Forebay gate timing for a planning study under	
3	a Priority 3 criteria	8-4
Figure 8.5:	Locations water levels are presented to show the impact of operating	
J	Clifton Court Forebay intake gates according to Priority 3	8-5
Figure 8.6:	Water levels at three locations in the south Delta under Priority 3 and	
J	Priority 4 forebay intake gate operation, 1991 planning conditions	8-6
Figure 8.7:	Outside Clifton Court Forebay 30-day running average daily of minimum and maximum water levels under Priority 3 and Priority 4 Clifton Court	
F' 0 0	Forebay intake gate operations	8-7
Figure 8.8:	Outside Tom Paine Slough 30-day running average daily of minimum	
	and maximum water levels under Priority 3 and Priority 4 Clifton Court	0.0
Ciaura 0 Ou	Forebay intake gate operations	8-8
Figure 8.9:	Inside Tom Paine Slough 30-day running average daily of minimum and	
	maximum water levels under Priority 3 and Priority 4 Clifton Court	0.0
Figure 8.10:	Forebay intake gate operations	o-s
rigule 6.10.		
	daily of minimum and maximum flows under Priority 3 and Priority 4	0.40
Ciaura 0.1	Clifton Court Forebay intake gate operations	0-10
Figure 9.1:	Locations that the DSM2 simulation results are compared to observed	0.2
Figure 0.0.	data	9-3
Figure 9.2:	Observed and DSM2-simulated 15-minute stage at RSAN072 (San	0.4
Figure 0.0.	Joaquin River at Brandt Bridge) during the February 1986 flood	9-4
Figure 9.3:	Observed and DSM2-simulated 15-minute stage at RSAN072 (San	0.4
Figure 0.4:	Joaquin River at Brandt Bridge) during the summer of 1988	9-4
Figure 9.4:	Observed and DSM2-simulated 15-minute stage at RSAC123	
	(Sacramento River at Georgiana Slough) before and after the stage	0.5
	reference-datum was changed on October 1, 1987	9-5

Figure 9.5:	Observed and DSM2-simulated 15-minute stage at RMKL005 (North	
	Fork of the Mokelumne River at Georgiana Slough) before and after the	
	stage reference-datum was changed on October 1, 1987	9-5
Figure 9.6:	15-minute observed and DSM2-simulated flows at RMID015	
Figure 9.7:	Daily-averaged observed flows and DSM2-simulated flows at RMID015	
Figure 9.8:	Daily-averaged observed EC and DSM2-simulated EC at RSAC081	
J	(Sacramento River at Collinsville), 1975 to 1989	9-8
Figure 9.9:	Daily-averaged observed EC and DSM2-simulated EC at RSAN018	
· ·	(San Joaquin River at Jersey Point), 1975 to 1989	9-8
Figure 9.10:	Daily-averaged observed EC and DSM2-simulated EC at RSAC081	
3	(Sacramento River at Collinsville), 1975 to 1982	9-10
Figure 9.11:	Daily-averaged observed EC and DSM2-simulated EC at RSAC081	
· ·	(Sacramento River at Collinsville), 1983 to 1989	9-10
Figure 9.12:	Daily-averaged observed EC and DSM2-simulated EC at RSAN018	
· ·	(San Joaquin River at Jersey Point), 1975 to 1982	9-11
Figure 9.13:	Daily-averaged observed EC and DSM2-simulated EC at RSAN018	
J	(San Joaquin River at Jersey Point), 1983 to 1989	9-11
Figure 10.1:	Comparison of winter salvage to average winter exports and in-Delta	
J	flows (USGS)	10-2
Figure 10.2:	Historical San Joaquin River inflow at Vernalis, 2005	10-3
Figure 10.3:	Historical State Water Project and Central Valley Project pumping from	
3	the Delta, 2005	10-3
Figure 10.4:	Particle injection locations for PTM study of historical 2005 Delta	
J	conditions	10-4
Figure 10.5:	Daily PTM results for historical and modified 2005 conditions, variable	
•	locations of injections	10-6
Figure 10.6:	PTM results per injection location averaged over time intervals	10-11
	· •	